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BULLETIN L. D. 145

LIGHTING DATA

EDISON LAMP WORKS

OF GENERAL ELECTRIC COMPANY

GENERAL SALES OFFICE

HARRISON, N. J.

The Lighting of Theaters and Auditoriums

Actual Illumination



Information Compiled by

A. L. POWELL

Lighting Service Department

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BULLETIN L. D. 145

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The Lighting of Theaters and Auditoriums

*Information Compiled by A. L. Powell,
Lighting Service Department*

Introductory

From time immemorial men have been accustomed to meet for amusement, edification and companionship and today we have for these purposes, the theater, the lecture hall and the club or lodge room.

The Greeks and Romans constructed gigantic theaters and colosseums for the enactment of their dramas and spectacles but in those days, we are told on good authority, "the performance began early in the morning, so early in fact, that some of the spectators



Fig. 1

Night Photograph of an Attractive Theater Illuminated Through Decorated Ceiling Panels. At each side of the proscenium arch, a luminaire in the form of a miniature castle is used. The mural paintings on the side walls, executed by a well known artist, are specially lighted by 100-watt *MAZDA C* lamps in mirrored glass reflectors on 15-in. centers behind ceiling beams. As the theater is designed for use of children, all the decorations are planned to have a special appeal to them.

came during the night before the performance." Such lectures or public meetings as were held took place either on the side of a hill or in the Forum and naturally occurred in the daytime for there was no satisfactory method of artificial lighting.

With our present complexities of business life, most meetings and performances occur after dark and generally indoors. Proper lighting is, therefore, a very important factor not only for the

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transaction of business and comfort of the audience, but also as a very effective means of decoration, and of creating a suitable atmosphere.

Electricity is almost universally applied for lighting, due to its safety, ease of control and adaptability. Our modern stage productions would indeed be impossible if we had to depend on the candles, oil lamps and gas burners of bygone days.

Entrance, Foyer and Lounge

At the entrance of the theater, it is necessary to have brilliant illumination to attract the passing crowd. The pupil of the eye contracts when subjected to this bright lighting and unless the foyer is fairly well lighted, it will appear dark by contrast. Since the eye requires a certain period of time to accommodate itself to changes in intensity we must gradually reduce the amount of illumination as we proceed from the entrance to the auditorium.

In attaining this end, it seems desirable to provide a moderate intensity of about five foot-candles in the foyer, and there is a wide latitude in the choice of equipment; hanging luminaires, pedestal lamps, wall luminaires and cornice lighting have all been applied with success.

A golden yellowish tone of light is frequently employed and proves very attractive. The hangings and wall decorations should be planned with due consideration to the color of the illumination. In other words, the fabric should be examined under the particular light to be used before it is selected. Under yellow light a deep blue appears as a slate green, a red appears orange, a green, yellowish green and so on. It is, therefore, possible to enhance the decorative value by the proper combination of color or to materially distort the appearance.

In the rest rooms, the decorative element is predominant and as the name implies, it is desirable to simulate the effects produced in the living room at home. A discussion of the various schemes of lighting applicable here will be found in Bulletin Index 41, Residence Lighting.

We proceed from the foyer to the lounge and a lower intensity of illumination, one to two foot-candles, is desirable here. As a contrast, a reddish amber tint of light may be used. The theater and motion picture house are becoming more elaborately decorated each year, and the value of light as a decorative medium is being appreciated more and more. It is impossible to go into detail as

to the many ways light may be used and we must content ourselves with a few specific examples.

There are frequently a number of translucent vases as part of the lounge decoration. Under ordinary conditions they are simply one element in the general scheme, dull and lifeless. If this room is illuminated as suggested with warm light and one vase has a purple light inside of it, another green, another blue, and so on, they will then stand in relief, touches of color and life.



Fig. 2

Rapid Egress from a Building is Promoted through Good Lighting A properly designed exit light casts its illumination on the doorsill and surrounding area, as well as indicating the location

By such means, beauties heretofore unappreciated become high spots of the decoration. Pure colors, rather than tints, are best for such effects as these, but should be selected with due consideration for surrounding colors. The lamp filament should not be visible through the glass and the surface, while appreciably brighter than the background, not brilliant enough to be glaring. Art glass inserts can be similarly treated. Silk shaded table and floor lamps and even wall units are among the devices to which pure color can be applied for essentially decorative effects (that is, no dependence is put on them for general illumination), the object, of course, being to obtain contrast and touches of high light.

In some foyers miniature waterfalls or fountains are installed. Colored lamps in suitable moisture-proof fittings can be concealed

behind the falling water and in the pool itself. A motor-driven flasher may be used to change the color of light continuously. The combinations are limitless and the fascination of watching the constantly varying play of color in the particles of water is indeed great.

Frequently clusters or bouquets of hothouse flowers are purchased to be used for decoration. They represent an appreciable expenditure and unless something striking is brought into play, they are scarcely noticed by the patrons for they fade into the background. How much more attractive the interior is when such flowers are spotlighted. A small automobile headlight reflector with concentrated filament lamp, fed by a storage battery or through a transformer, can be effectively concealed and used to direct a beam of light on the flowers. Small floodlighting projectors with standard voltage lamps or even ordinary deep bowl reflectors with low wattage lamps have been applied with excellent results.

In other instances marble busts, statuettes and the like are placed in niches but receive no special lighting treatment. Concealed colored lamps can be used to produce some very striking effects. The application of tinted light to statuary or architectural details is one of the most interesting phases of illumination. For example, if an object in relief is lighted by red light from one side and by green light from the opposite side, the shadows cast by the red will be illuminated in green; those cast by the green light will be high spots of red light, at points where both colors mix, yellow light will result. The play of light and shade in color is truly marvelous. Delicate shadings from one tint to another are produced and unthought of, hidden beauties brought to life. With three colors still more startling effects can be secured.

These effects of light can be well studied by using a small black box or booth with colored lamps at different points so wired that they can be readily controlled.

Theater Auditorium

When one reads a bulletin of this nature, he expects to find definite data that will indicate how to light the type of building under consideration. Occasionally, from the very nature of the problem, he will be disappointed. Such is the case with the theater auditorium. As with the church, there is purposely no standardization of architectural treatment or decoration. It is well so, for

thus we avoid monotony and secure interest. No two theaters are identical, their shapes and sizes varying according to no rule. Ceiling and wall decorations are widely different and even the ideals of the designers may be at diametrically opposite points



Fig. 3

This View is Indicative of the Elaborateness of the Lighting Equipment in a Modern Motion Picture Theater. The ceiling of the auditorium is of unusual beauty with a great dome 54 ft. across in the center which is lighted by 200 concealed lamps of various colors. At the center is suspended a chandelier of solid bronze, weighing 2500 lbs., 20 ft. long with a spread of 12 ft. This is fitted with 220 candle type lamps. The outer ring of the dome is illuminated by 16 indirect luminaires of unique design. A portion of the proscenium arch is of glass illuminated from behind and furnishing colored lighting effects during the overture.

It is therefore safe to say that no two auditoriums should be similarly lighted and the best that can be done in discussing the question is to lay down certain general principles which should be followed and then mention a few schemes of illumination that have proven satisfactory.

The theater must first of all be comfortable, for no matter how interesting the production, if we are annoyed by brilliant lights between acts, we are not in a condition of mental ease.

A high intensity of illumination is not necessary nor desirable. If from one to two foot-candles are provided throughout, there will be enough light for reading programs and seat checks as well as making access to seats an easy matter. On the other hand, the mistake can be made of having too low an intensity, causing severe eyestrain in the attempt to read. Some producers with fixed views on the matter actually provide so little light that this condition prevails.

It may often be desirable to vary the amount of light in the auditorium previous to the opening of the performance and between the acts. The eye accommodates itself to the lighting provided. If, for example, the curtain rises on a scene in a mystery play where the stage is quite dark, and it is not desired that movements be seen with certainty, then a rather high intensity of illumination in the auditorium will heighten the effect by contrast. Similarly, if the curtain rises on a moonlight scene which although dim should be seen clearly, and too high an intensity has been prevailing in the house the setting appears abnormally dark by contrast. It would have been better to have lighted the room to a lower value.

It is almost always desirable to gradually dim the house lights as the stage lights are brought up, rather than "pulling the switch" with resultant extreme contrasts.

With some types of structures a large central luminaire (Fig. 3) is best suited, for others a distributed arrangement of outlets is logical (Fig. 1).

If the luminaires are of the direct type, no matter how elaborate their design, care should be taken that the visible sources are of low brightness and also that they are not normally viewed against a dark background. For most conditions side walls should not be particularly bright as a subdued rather than a brilliant effect is generally desirable. Where the ceiling is light in color, indirect luminaires find application or lamps can be concealed by coves or cornices.

Lamps concealed by art glass panels set flush with the ceiling (Fig. 1) or above a skylight offer another means of securing the desired result. This scheme is especially well suited beneath the balconies, where pendent fixtures would interfere with the view. With recessed lighting units, it is well to have some auxiliary units to avoid a dark ceiling.

The practice of studding architectural details with small lamps has little to recommend it either from the illumination or artistic standpoints.

It is required by law and desirable for the safety of patrons to provide lights indicating exits. Sometimes the luminaires used for this purpose merely mark the location of the door. Other equipments are so designed that they not only mark the exit but also provide sufficient illumination to allow convenient egress when the auditorium is in darkness. As indicated by Fig. 2, the light is thrown on the steps and not in the main body of the room.



Fig. 4

Night View Beneath the Balcony in a Medium Sized Motion Picture Theater. Totally indirect equipment is employed, a number of MAZDA C lamps and mirrored glass reflectors being concealed by an ornamental composition housing. The location of outlets conforms with the decorative treatment of the ceiling. Soft, well diffused, glareless illumination is provided

Motion Picture Auditorium

The day of the dull, darkened motion picture auditorium is rapidly passing and the time is not far distant when suitable illumination will be made mandatory. This will not work a hardship on the industry, for proper lighting will make the theater more attractive, reduce the liability of panic and eliminate the gloom which is always attendant with a darkened room. All these features will tend to increase the attendance, which, of course, is the end toward which the management strives.

Contrary to the general impression it is quite feasible to provide sufficient illumination for patrons to find their way to the seats and even read the program without interfering with the appearance of the picture. Intensities in the order of .2 foot-candle at the rear of the house and .1 foot-candle at the front meet these conditions. Bright light sources must be eliminated if comfortable conditions for viewing the picture are desired and hence the indirect systems of illumination are of especial service here. A considerable amount of investigation work has been done on this subject which is covered in one of the references cited in the bibliography.

In addition to providing the low intensity desirable while the picture is being shown, it is necessary to have a means of instantly flooding the auditorium with light. Fires, smoke, explosions, etc., are factors which often cause an audience to become panic-stricken. If with adequate lighting they can see for themselves the proximity of the danger, the chances of accident are decidedly reduced.

While it is true that the low intensity of illumination can be obtained through the use of dimmers inserted in the circuits, it is preferable to have the fixtures constructed to accommodate two or more circuits. Thus low wattage lamps can be burned at their proper efficiency for the low intensity and the loss of power in the resistance is avoided. Dimming devices are of course necessary to obtain gradations of color, when such effects are used.

In those auditoriums where it is not deemed advisable to supply at all times sufficient general illumination for the patron to find his seat with safety, so called aisle lights are employed to advantage.

The indirect system of illumination can be made to be decorative and as ornamental (note Fig. 4) as any of the other systems which may be less applicable to this particular problem. It has the additional advantage that any degree of uniform illumination can be obtained without introducing glare. A fairly high intensity produced with the ordinary systems of direct lighting is quite likely to introduce glaring conditions. Most of the modern theaters have elaborately decorated ceilings and the upward light is an advantage.

Indirect lighting does not necessarily mean monotony. In recent years many forms of indirect equipment have been developed which permit a wide latitude in choice of equipment. Ornamental bowls in various decorations, pendant from the ceiling, are probably

the most commonly encountered form. Coves and cornices can be well utilized for concealment of lamps and reflectors. Large portable floor stands so placed as not to interfere with the view have been applied. Wall brackets and urns with inverted mirrored reflectors are also called into play where there are no cornices



Fig 5

An Example of the Elaborate Type of Luminaire Installed in the Modern Motion Picture Auditorium. Inverted mirrored glass reflectors are concealed within the crystal structure and so placed that they direct the light from Mazda C lamps to the ceiling without striking the crystals. Floodlighting projectors directed on the luminaire cause it to sparkle and glow. In addition, a large number of small lamps with concentrated filaments furnish direct light for extremely brilliant effects used during intermissions

available. In the long narrow theater with a low ceiling, it is often desirable to use indirect wall luminaires in order to avoid interfering with the projection of the picture. In some instances, the front edge of the balcony has been extended and with special construction used as a location for indirect lighting units.

Even where indirect lighting is employed for the principal source of illumination, the effect of a direct lighting installation

can be obtained by so designing the main fixture that it is luminous on the exterior (Fig. 5). Even the cut crystal with its scintillating beauty has been employed for this purpose. Fixtures have been made carrying inverted mirrored glass reflectors with relatively large efficient lamps, the reflectors concealed within a framework or housing and this in turn surrounded by a crystal casing. Alone the crystals would appear dull and lifeless but skillfully placed and properly directed floodlighting projectors send beams of light on the exterior of the fixture, causing it to have the desired sparkle. Similarly the candlestick with silk shade has been employed in conjunction with the large units.

Where cornices and coves are used for concealing the light, attention must be paid to the equipment of these. Frequently, through a desire to save on the original cost, receptacles are placed within the cove and no reflecting device whatever provided, the rough plaster finish being used. Needless to say, this has relatively little reflecting power and moreover, unless the contour of the cove is designed by someone who understands the principles of light reflection, it is an accident if a favorable distribution of light results. Mirrored glass reflectors are very efficient for this purpose and should be employed. Enameled reflectors are next in order of desirability. A reflecting surface finished in paint is likely to deteriorate very rapidly and plaster is open to the same objection. Small particles of dirt lodge in the crevices between the particles of plaster and reduce its reflecting power.

Not only is the question of the design of the cove and choice of reflecting equipment for use in it of importance but observation of actual installations of this type of lighting indicates oversight of an element which must be given attention if the lighting is to be permanently successful. This is the cleaning of lighting equipment. In many instances months and even years elapse without a thorough cleaning. The only attention the lighting receives is an occasional replacement of burned out lamps and this is not attended to until the effect becomes so spotted that it is extremely noticeable. The accumulation of foreign material on the reflecting surfaces and lamps is indeed heavy, and it would be fair to assume that with the neglect so prevalent the depreciation factor which must be applied to the installation is considerably over 50 per cent. In other words, half of the light which is being paid for is being lost through dirty conditions.

The orchestra lights in the moving picture auditorium should be carefully selected. If poorly designed with considerable reflected or "spill" light, they are annoying to the audience and also affect the clearness of the picture. Several really satisfactory types utilizing the indirect principle are now on the market.

Attention should be paid to the color of the "frame" surrounding the picture. The deep black frequently employed is not well suited, for it creates too severe contrast, a rather light tone of gray is preferable.

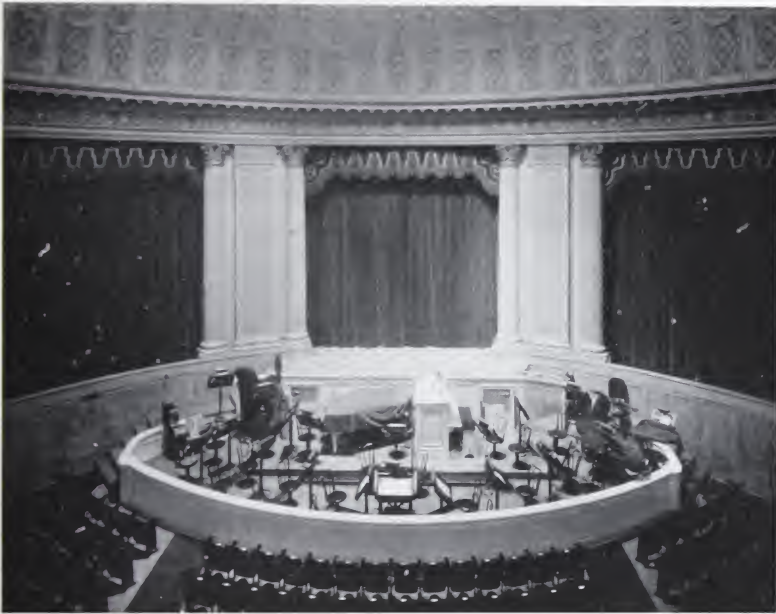


Fig 6

An Orchestra Pit Floodlighted by Projectors with Concentrated Filament Mazda Lamps Concealed Above the Ceiling, the Beams of Light Coming Through Openings

In many of the larger more modern houses, elaborate systems of colored lighting are installed. The use of colored light for psychological and decorative effects is unquestionably most desirable, and we shall see more of this as time progresses. At present, however, huge clusters of lamps of pure color are often visible and the lighting fixtures themselves rather than the lighting effects become the center of attraction. The novelty appeals but this method of illumination is scarcely subtle enough to endure.

Eventually light will be applied with greater ingenuity or skill and delicate effects, rather than an obviously crude method, will come into use.

Colored light is of great value in the motion picture house in connection with the musical program. The relation of light and music is not as indefinite as many imagine, and this question is discussed in detail in a later section.

The lighting of the motion picture auditorium will undoubtedly go through the same transition that the "world's fair" has experienced. In the days of the St. Louis, Jamestown and Buffalo Expositions, bare incandescent lamps were studded over all the buildings to furnish so called "outline" lighting. The effect was striking at first sight, but was not of a quality which caused one to pause and admire for an appreciable length of time. At the Panama Pacific and at the Brazilian Centennial Expositions, outline lighting was tabooed. Soft pastel shades and tints were employed, lamps were concealed from view and the beauties of the architecture brought out through painting with light. We might use an analogy to still further illustrate this. In music the obvious soon dies, but the composition with hidden beauty survives. Most of the popular airs of a generation ago are unknown to the youth of today but Beethoven's "Minuet" will be "popular" centuries hence.

Concert Hall and Assembly Room

As with the theater auditorium, it is again impractical to lay down any general scheme for lighting, as one type of architecture may require an entirely different treatment from some other style.

Overhead lighting from symmetrically placed luminaires is unquestionably the best scheme. Bracket and side wall lamps are generally objectionable for they come within the angle of view. Where they are absolutely necessary as part of the decorative scheme, they should not be depended on to furnish appreciable illumination, but merely to provide a touch of light and color. Small lamps should always be used on such brackets and even these carefully shielded. They should never be located directly behind the speaker or on the stage and if the platform happens to be placed near some side wall units, these should be turned out for the time being.

If the ceiling is dark or very broken in structure, direct lighting is necessary and a wide variety of equipment is available. Where

the ceiling is light in color, the indirect systems prove very satisfactory. Semi-indirect bowls and totally indirect luminaires are standard with decorations harmonizing with the various architectural periods, Gothic, Adam, Louis XIV, etc.

The auditorium in the school, or room of similar nature, can often effectively be lighted with the same general type of luminaire used in the other portions of the building with possibly the addition of an ornamental hanger and a slight amount of decoration on the glassware. An example of this simplicity will be noted in Fig. 7



Fig 7

Night View of a School Auditorium Illuminated by Opalescent Glass Enclosing Units of a Very Simple Type, with 200-watt MAZDA C Lamps on Centers 15 x 20 Feet

The illumination intensity is between four and five foot-candles. The stage is illuminated by sixteen 50-watt MAZDA lamps in porcelain enameled angle reflectors directly behind the arch

In other classes of meeting rooms, for example, the hotel ballroom, the character of the building demands special, highly ornamental luminaires. Hanging cut crystal fixtures with a multiplicity of clear lamps (Fig. 8) are frequently employed. While this is not ideal for use during meetings, nevertheless the sparkle produced is especially well suited when the room is used for dancing, giving life and creating the feeling of joyfulness. These two examples indicate the wide range of practice.

No very definite rules can be given with regard to the arrangement of lighting outlets as the architectural features of the room

are the determining factors. They should usually be placed symmetrically with regard to the ceiling beams or panels. The number and size of lamps will depend on the dimensions of the room and from a standpoint of economy of operation and simplicity of wiring it is best to use as small a number of luminaires as possible. This arrangement has advantages over a large number of small units for fewer light sources are in the field of view. On the other hand, due care must be taken that the entire seating area is evenly illuminated.



Fig. 8

Utilitarian Methods of Lighting Are Indeed Out of Place in the Hotel Ballroom

Elaborate crystal glass chandeliers are quite in keeping and flame type candle-labra lamps desirable as part of the decorative scheme. Where side wall luminaires are employed, tinted diffusing bulb lamps find application.

The desirable intensity of illumination will depend on the uses to which the room will be put. If meetings alone are contemplated, approximately two foot-candles is adequate. Where the room will be used for various other purposes, such as fairs, dancing and exhibitions, provision should be made to supply at least five foot-candles. In the latter case, it is well to have the lighting on at least two circuits so that either the lower or higher values may be available at will.

Convenience outlets along the baseboard at frequent intervals are necessary for attaching decorative lighting for booths or displays. An outlet of sufficient capacity is necessary at the rear

of the hall for stereopticon and motion picture machines, as well as an outlet near the speaker's platform to which a reading lamp can be attached. Provision should be made for music lights at the probable location of the orchestra.

Stage pockets with heavy wiring should be located at various points about the balcony so that projectors can be attached for special effects during dancing. Automatically operated or hand-



Fig 9

Even Though Local Conditions are Such as to Make It Impossible to Take Advantage of the Full Possibilities of Lighting in the Lodge Room, the Question Should Not be Neglected. This night photograph indicates a very simple yet suitable installation. A fairly high intensity of illumination is furnished by two 300-watt Mazda C lamps in large opalescent glass semi-indirect bowls. The emblem of the order in blue is pressed in the decoration of the bowl and stands out against the white glass. The decoration of the glassware used with the inverted wall luminaires harmonizes

controlled color wheels are used to throw beams of constantly varying, tinted, light on the dancers. Some most ingenious and striking effects can be produced in this manner.

Lodge Room

The possibilities in this field of lighting have never yet been fully realized. All too frequently does one see, in the most costly and elaborate buildings, luminaires of very ornate character, well made, and for many purposes excellent, but not at all adapted to the peculiar requirements of the lodge room.

Many wonderful effects can be obtained with properly applied lighting and the initiatory ceremonies can be made much more beautiful than any but an experienced lighting artist would imagine. Full advantage should be taken of the decorative and psychological effects of colored light. The room should be so wired and luminaires so designed that the working space can be flooded with the three primary colors, red, green and blue. These can be used either pure or mixed in any desired proportions to obtain all the intermediate tints. Thus, as the work progresses, the blue-green of the moonlight can be simulated, the reddish value of the setting sun imitated, or the brilliant white light of midday obtained. Most ceremonies give opportunities for introducing just such effects as these.

The architect who plans the building should be conversant with the work and make due provision for the installation of overhead spot lamps giving touches of light at the various stations. If considered in advance, these can be recessed so that the equipment is flush with the ceiling and the effect of the room is not spoiled, as would be the case where lighting apparatus is an after-thought.

Where especially designed luminaires are not used, one has a choice of a wide variety of standard equipment of the semi-indirect (Fig. 9) and totally indirect types with the Elk's Head and the Mystic Hour of Eleven, or the Square and Compasses, the Three Links of Fellowship, and the like as part of the decoration. The lodge room should be wired with a number of convenience outlets for the attachment of apparatus for special occasions. Provision should be made for a well shaded light at the organ and conveniently located dimming devices are essential.

Building Exterior

The exterior of the building should be illuminated to attract the attention of the passing crowd. This may be accomplished by several means.

An extremely high intensity of light is often used adjacent to the entrance. Several high candle-power MAZDA lamps equipped with weatherproof fixtures and diffusing globes are suspended from the building, beneath the marquee, or placed on ornamental standards at the front. In other instances, the under portion of the marquee is literally studded with diffusing bulb lamps to produce the desired effect as in Fig. 10.

A somewhat more spectacular method of bringing the building into prominence is the use of elaborate electric sign equipment and outline lighting. More detailed data on this phase of the question will be found in Bulletin Index 93, The Lighting of Signs and Billboards.



Fig 10

High Intensity Illumination of a Distinctive Character is Furnished in Front of this Theater by Closely Spaced 100-watt MAZDA C Daylight Lamps Beneath the Marquee. An attractive sign with a border of the primary colors forms an excellent and striking contrast

Probably the most dignified and artistic means of building front illumination is obtained through floodlighting. For floodlighting to be effective, the surface must be relatively light in color and the surroundings fairly dark. It is necessary to have suitable stations for the location of projecting equipment as pointed out in Bulletin Index 95, Floodlighting and Its Applications. Several of the more recently constructed buildings have taken this matter into consideration and the marquee has been so designed that projectors can be located on it.

The exact scheme to employ will depend to a great degree on the character of the building and its location. If of a monumental type, well proportioned and dignified, floodlighting is best suited. If the façade is not particularly attractive, it may be well to partially hide it by an electric sign. If situated somewhat off the regular run of traffic, the high intensity scheme will tend to divert the crowd.

Light and Music

One of the most interesting phases of the application of colored light is in connection with music. It is a fascinating subject to the experimenter, be he scientist, decorator or musician. To all intents and purposes, it offers a virgin field for constructive effort and the Motion Picture Theaters constitute a huge laboratory extending from coast to coast.

To obtain results, one must have apparatus with which to conduct experiments and fortunately we have them; huge symphony orchestras under the direction of capable, sincere, progressive conductors, adequate capacity in electric current to supply the necessary light, flexible control of switching apparatus, electrical men with ingenuity in the handling of light, and audiences, varied in character, as subjects. Surely one could not ask for a better set of conditions.

It is not strange that the coordination or joining of light and music has not been developed to a greater degree. Broadly speaking, appreciation of music itself is comparatively modern and it was only in the last few years that adequate means of controlling and changing or modifying the light have been available. The future looks very bright. Within the last decade, several very creditable attempts have been made to combine light and music and more and more investigators are interesting themselves in the subject. Individually, one can accomplish very little, but as pointed out above, when the Motion Picture Theaters with their trained organizations take up the matter actively, the art should advance by leaps and bounds.

There are several fundamental features which work for the success or failure of the endeavor and these must be borne in mind. It is well, therefore, to stop and study the question before attempting to enter into the details. The first question which comes up is, "How will the light affect our emotions?" Primarily through association. We associate green, for example, with the

quiet restful wood or meadow, yellow with the warm sun, red with fire, danger, war and carnage, blue with the calm sea and sky. In addition to these associated attributes or qualities, experience and experiments have proven that color has a direct effect on our nerves and emotions. Reds are exciting, yellows, stimulating and buoyant, greens, quieting and calming, blues and violets often make us depressed and subdued. Bearing these points in mind, it is well to digress slightly.

Light is similar to sound (music) in more ways than most of us realize. One is received by the eye, and the other by the ear and then conveyed by nerves to our brain where we get the impression. Both light and sound are produced by vibrations. A deep tone is produced by a slowly moving wave or vibration, a high pitch by a much quicker movement. We have a so-called octave of sound, c, d, e, f, g, a, b, c, and what might be termed an octave of light, red, orange, yellow, green, blue, indigo and violet—the red vibrating much less rapidly than the violet. Due to this similarity, some experimenters have made the mistake, the writer believes, of attempting to assign tonal values to the colors of the spectrum, just as though they were to play a scale in colors, or write a score for color as they would for sound.

As a somewhat exaggerated illustration of the point we are trying to bring out, an experimenter might try to write a color score for "America" (My Country, 'Tis of Thee). His music would read c, c, d, b, c, d, e, e, etc., his light score might read, yellow, yellow, green, orange, yellow, green, blue, blue, etc.

It is obvious that attempting to follow any such practice as this would lead us nowhere and that we would have a meaningless, unintelligible result. We must have our tie-in between the two senses—hearing and sight—based on the association element. We must study how both light and sound affect our feelings. Realizing this, it is evident that rather than an individual note having a corresponding light to accompany it, a group of notes, that is a mood or theme of the composition, or even a whole section, will have a much more definitely associated color. For example, one would naturally associate green with a pastoral bit, red with martial music, vivid yellow with the bright, sprightly dance, blue with moonlight, blue-green with the barcarolle and so on.

The next point to be kept in mind is the method of applying color. The first extensive attempt made in America along this was at Carnegie Hall, four or five years ago. The Russian com-

poser Scriabine had prepared the score of a number, with color accompaniment (*Poem of Fire, Prometheus*). One instrument of his orchestra was what he termed "tastiera per luce" (light keyboard). This was a box about five feet square with a white background on which colored light could be thrown and varied in intensity and tone (color). He wrote a score for this device and introduced it at will, as he would a part for the woodwinds or brass. Sometimes, one color would be visible for quite a period, then there would be a rapid variation of tint. The box which he used was so small that the effect was lost at the rear of the hall. The effect of the color was lost in competition with the huge orchestra.

We see by reflected light and to get the maximum impression of color, there must be a relatively large light colored area on which tinted light can be thrown. One way of accomplishing the desired end would be to flood the entire auditorium with tinted light, so that one "feels" the atmosphere. This can be accomplished by the use of concealed lamps in inverted reflectors placed in a cornice for indirect lighting. Again, the curtain and draperies at the front of the house might be of a light neutral tint and colored light from concealed sources thrown on this, or the orchestra itself could be clothed in white suits and beams of colored light projected on this area. (Fig. 6.) Suitable connections of circuits of the three primary colors, red, green and blue, with dimming devices will permit the use of any combination or mixture desired.

Having the means at hand to get color effects on a large scale, it will be up to the musician to co-operate with the man who has observed the effect of color on our emotions (the psychologist or artist) and with the man who knows how to produce the lighting effects (the electrician or engineer). The musician will outline to the psychologist the impression which the music is supposed to create. The latter will determine what color is most likely to be associated with this emotion and the engineer will see that the right color is available at the proper time.

One can visualize the time when sufficient information has been obtained from experiments to lay down certain definite fundamental rules and then still further to the time when these effects will be appreciated by the general public. This will not be a difficult matter, for most of us are affected by music.

We are stirred at the sound of the military band, the soft soothing strains of the *Humoresque* or *Kammenoi-Ostrow* rest

us and quiet the nerves, while the modern jazz tune has still another effect. Some of us experience the whole gamut of human emotions, listening to the wonderfully descriptive music of Massenet, Puccini or Wagner. Particular phrases promote sorrow or joy, depress or exuberate us. Light has a similar effect, the colorings of nature as expressed in sunrise or sunset give one a thrill, the cool, restful green of the wood has its effect, while the changing blues and white caps of the sea also produce an impression. Certainly these can be combined.

In many of the larger Motion Picture houses, it is a regular practice to vary the lighting while the orchestra plays the prelude or special numbers. Observations indicate that while some of the effects obtained are excellent, at times there is apparently little connection between the music and the lighting. Even though the lighting is most artistic, it should most certainly be in harmony with the music. Careful forethought along the lines suggested should produce the desired result.

It is going somewhat out of the province of this bulletin to lay down detailed programs for various selections. There are certain descriptive numbers which are particularly susceptible to color treatment, for example, Wagner's "Ride of the Valkyries," "Siegfried's Funeral March," "Good Friday Spell," Tschai-kowsky's "Marche Slav," "Overture 1812," Rimsky-Korsakow's "Scheherazade," "Sadko," "Ballet Music from M'lade," Rachmaninoff's "Island of the Dead," Rossini's Overture "William Tell," Von Suppe's Overtures, and so on.

The numerous themes offer great possibilities for changing colors. Flashes of one color can be superimposed on another. A shrill, piercing note can be accentuated by a brilliant, momentarily exposed light. At times, the change from one color to another will take place gradually, at other parts abruptly.

We can all look hopefully to the future for great advances in combining the arts of music and light.

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